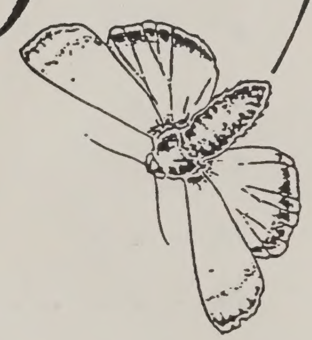
United States
Department of
Agriculture

Agricultural
Research
Service

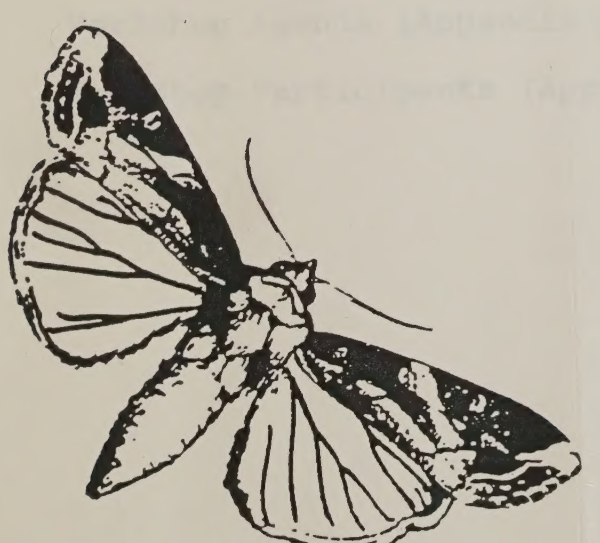
REPORT

SOUTHEASTERN
BEET ARMYWORM WORKSHOP



Tifton, Georgia

October 22, 1991



National
Program
Staff

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Preface

This report details the pest status, current research, and research needs and priorities established during the southeastern beet armyworm workshop held in Tifton, Georgia, October 22, 1991, and represents a proposed fundamental and applied beet armyworm research program in cooperation with universities and other State and Federal agencies. A cohesive team effort is to be mounted to help solve specific problems related to the beet armyworm as resources become available. This requires the formulation of an action program that defines program goals and objectives, identifies project relevance and role, identifies activities to reach the objectives, and provides a basis for full participation of ARS scientists and cooperators in planning the program and strategy. This report provides an important foundation for program strengthening and expansion, coordination, decision making, and implementation by the ARS National Program Staff and its cooperators.

The National Program Staff expresses its gratitude and appreciation to all for participating in the organization of the workshop and in formulating and prioritizing the research needs to address this emerging pest. The workshop was highly productive and met the objectives set forth. We are especially indebted to the representatives from the universities, state agencies, and the representatives from the commodity groups, producers and consultant firms for their valuable interactions and contributions, as well as the ARS scientists.

Robert M. Faust
National Program Leader
Crop Protection

James R. Coppedge
National Program Leader
Field Crop Entomology

EXECUTIVE SUMMARY

The beet armyworm (Spodoptera exigua) has a long history as a pest of cotton and vegetable crops in the western United States. However, its behavior changed in 1984, and through 1987, scattered outbreaks occurred in cotton throughout the southeastern Coastal Plain. In 1988, the beet armyworm emerged as a devastating pest of cotton in the Southeast. From 1988-1990, the beet armyworm was the most destructive pest of cotton in the Southeast, causing record losses and the abandonment of large cotton acreages. Peanut, soybean and vegetables also suffered significant losses due to the beet armyworm. Its economic impact in southeastern agriculture continued into 1991, as large acreages of cotton were not planted because of the excessive losses that had occurred the preceding three years.

Knowledge of the beet armyworm's biology, ecology, and population dynamics in the Southeast is limited. Also, its control has been highly unpredictable with available pesticides and application strategies. Because so many unknowns have hampered economical management of the beet armyworm in the Southeast, leaders from farming, industry, extension and research developed an Action Plan for addressing priority research needs on:
(1) monitoring/survey, sampling and economic thresholds; (2) prediction capability; (3) biological control; (4) biotic and abiotic environmental variables; (5) pesticide application technology; (6) pesticide efficacy; and (not ranked) fundamental biology, area-wide management strategies, cultural and autocidal control, and pesticide resistance management.

Research on the beet armyworm priority needs will begin as resources become available.

OBJECTIVES & CHARGE TO THE WORKSHOP

The charge to the Workshop was to evaluate the pest status of the beet armyworm in the Southeast, and to assess needs and opportunities for research that will lead to effective but environmentally sensitive management strategies. The Workshop was designed to provide an open forum for expressing views and ideas for both immediate and future research needs.

Specific Objectives were to:

1. Foster improved communication and linkages among scientists and others having an interest in beet armyworm management.

2. Determine the current status and constraints in using available knowledge and technology for managing the beet armyworm.

3. Determine research needs and opportunities for integrating interdisciplinary, interagency, and industry resources for managing the beet armyworm.

4. Delineate ARS roles and responsibilities in implementing identified research needs and opportunities.

INTRODUCTION

Twenty-one participants (see Appendix) representing farming, consulting, cotton industry, extension, and research across the Southeast met on October 22, 1991, at the USDA, ARS, Insect Biology and Population Management Research Laboratory, Tifton, Georgia, to assess the pest status of the beet armyworm, evaluate current research, identify and prioritize additional research needs and delineate ARS' role in future research on this emergent pest of southeastern agriculture.

PEST STATUS

The beet armyworm, *Spodoptera exiqua* (Hübner), is native to Southeast Asia. Since its discovery in California in 1876, the beet armyworm has spread across the southern half of the United States. Typically, the beet armyworm has been an economically important pest of cotton and vegetables in the semi-arid regions of the West, or as a late season pest in other parts of the country. The beet armyworm historically has been a pest in the Southeast only during abnormally dry years, e. g., 1977 and 1980-1981.

Infestation patterns for the beet armyworm in the Southeast changed in 1984. The insect began attacking cotton early in the season, and damaging infestations were scattered throughout the Southeast in 1986 and 1987. By 1988, the beet armyworm became particularly devastating to cotton on the Coastal Plain of Alabama, Florida Panhandle, and Georgia during 1988-1990 and in South Carolina in 1990. For example, it destroyed from 75-100% of 10% of the cotton acreage in southeastern Alabama, and from 35-40% of an additional 30% of the acreage in the state. Also, the beet armyworm caused the abandonment of 33% of the cotton in northern Alabama in 1990. The economic loss caused by this insect in Georgia appears to have been as great as it was in Alabama (Table 1). Sporadic problems with the beet armyworm also appeared in the Mississippi Delta during this period. In recent years, peanut, soybean, and several vegetable crops also have suffered losses caused by the beet armyworm. Larvae of this pest feed primarily on foliage during the early and late periods of a cropping season; during the mid-season, larvae also feed on young fruiting structures (flower blooms, squares, and bolls) of cotton.

Recent (1988-1990) severe infestations of the beet armyworm in the Southeast coincided with drought and intense spraying of cotton to control the boll weevil. A prevalent theory is that abnormally dry conditions and blanket applications of organophosphates to eradicate the boll weevil destroyed natural enemies that otherwise might have helped to regulate larval populations of the beet armyworm. Evidence may support the theory; in 1991, precipitation

through mid-season was considerably above normal, cotton sprayed for the boll weevil decreased to less than 11% of the acreage (down from 95% in 1988), and severe beet armyworm problems were limited to less than 10% of the cotton acreage after rains had stopped in late August or early September. Although the direct costs for controlling the beet armyworm in 1991 were not as great as in the preceding three years, its economic impact on the 1991 agricultural economy remained high. If the beet armyworm had not been such a devastating pest from 1988-1990, there almost certainly would have been a much larger cotton acreage in the Southeast in 1991.

The beet armyworm is difficult to control with available chemicals and/or application technology. Compounds that have been used for its control include Bolstar, Curacron, Dimilin, Larvin and Lorsban applied by aircraft and ground rigs in various combinations with and without vegetable oils or spreaders. Efficacy of treatments range from non-existent to satisfactory population suppression (but seldom complete control) with repeated applications, depending on efficiency of respective farming operations. In some cases, control expenditures of $42-$90/acre gave adequate suppression of the beet armyworm. While in other cases, similiar expenditures resulted in control failures and crop abandonment. There also were reports of control costs reaching $200/acre in attempts to salvage crops. Unpredictability in control efficacy for the beet armyworm has been a common theme throughout the Southeast. In the absence of pesticide pressure, natural enemies appear to be important regulating agents for larval populations of the beet armyworm. Braconid parasites, particularly *Cotesia marginiventris*, receive notoriety as important natural mortality factors for the beet armyworm. However, such observations remain inadequately documented and lack quantification for the Southeast.

CURRENT RESEARCH

A query of USDA's Current Research Information System (CRIS) indicated that 16 current projects in the U. S. involve research on the beet armyworm; none, however, is designed specifically for the beet armyworm. In each of the projects, the beet armyworm is either an indicator species for technology being evaluated, or it is one of several species considered collectively. For example, in the Western U.S., five projects in Arizona and California concern cotton and tomato resistance to several pests, and management systems for multiple pests in vegetables. Two projects in Mississippi and Texas study management strategies for pests in soybean and vegetables, and microbial control of whiteflies, aphids and several species of noctuid pests (e.g., bollworms, armyworms, loopers, etc.). The objectives of eight active CRIS projects in the Southeast include the use of pheromones to manipulate populations of noctuids (ARS, Gainesville, FL), monitoring the development of pest resistance to chemicals, developing pest management systems for cotton and pest-resistant soybean, and the use of multiple cropping systems to manage insect populations (Univ. GA.),

[illegible] resistance [illegible]
[illegible] weevil dependent [illegible]
in 1987, [illegible]
than 10% of the cotton acreage [illegible]
uses or [illegible]
the [illegible]
five years [illegible]
any [illegible]
[illegible] EP-16 [illegible]
[illegible]

[illegible]

A query of USDA's Current Research Information [illegible] listed which current projects [illegible] the U. S. [illegible] (bollworm/budworm); none, however, [illegible] designed to [illegible] fall armyworm. In each of the projects [illegible] an insect pest species for feasibility using aerial [illegible] of several species considered collectively) [illegible] (e.g., [illegible] and [illegible] to [illegible] climate resistance of several pests [illegible]

[illegible] pests [illegible] one [illegible] study [illegible] strategies [illegible] and microbial control in [illegible], [illegible] noctuid pests, e.g., [illegible] armyworm [illegible] objectives of [illegible] activity [illegible] the use of pheromones to monitor [illegible] (ARS [illegible] Gainesville, FL). Monitoring [illegible] resistance to chemicals, development of pest management [illegible] and pest-resistant [illegible], and the use [illegible] to [illegible] insect populations [illegible].

and developing soybean with multiple pest resistance, managing Heliothis and other pests in boll weevil-free cotton, and pathogens for regional pest management systems (Clemson Univ.).

Observations associated with current research activities permit several qualitative assessments on the status of the beet armyworm in the Southeast. The beet armyworm appears to favor skippy, stressed, dryland, late-maturing, Acala-types, and specific varieties of cotton in certain fields on sandy soil. Although larvae readily defoliate cotton, they also feed on fruiting structures (bracts, squares, blooms, and young bolls) which may become their primary food during the middle of the cropping season. The beet armyworm tends to be a late-season pest, but recently it has become an early-season problem on seedling cotton, vegetables and whorl-stage corn. Pigweeds (Amaranthus spp.) are favored wild hosts for the beet armyworm, and their occurrence in agricultural settings may significantly influence population dynamics of the pest on crops. The beet armyworm is a migrating species whose outbreaks in the Southeast appear to depend on large influxes of adults from south and/or central Florida. Even though adults of the beet armyworm are captured in pheromone traps in South Alabama and Georgia in mild winters, its ability to overwinter in these areas has not been confirmed.

Natural enemies are thought to be a major regulating force against beet armyworm populations in the Southeast. Braconid species commonly parasitize larvae and appear to negatively impact beet armyworm populations more severely than do pathogens. Cotesia marginiventris is thought to be an efficient parasite of beet armyworm larvae, but its relative role in managing populations remains to be quantified. An exotic parasite, Telenomus remus, appears to be efficient in parasitizing eggs of the beet armyworm in the laboratory. It was difficult to establish the beet armyworm in field cages in southeastern Alabama when natural enemies were permitted access to artificially infested larvae. When natural enemies were excluded from cages, larvae easily became established. Populations of most species of parasites are severely depleted when they are sprayed with organophosphates. Pyrethoids are less severe than organophosphates, and carbamates less severe than pyrethroids, against parasites.

Success in controlling the beet armyworm is unpredictable among regions, weather conditions, and methods used for the application of insecticides. Chemicals that are efficacious in the laboratory often provide poor to marginal control of larvae in the field. Compounds that are commonly used against larvae of the beet armyworm include Bolstar (sulprofos), Curacron (profenophos), Dimilin (diflubenzuron), Larvin (thiodicarb), and Curacron/Lorsban (chloropyrophos) mixes. Incorporating crop oils or spreaders in the materials often increases efficacy of the treatment. Successful control also varies with method of delivering compounds, types of equipment used, and other unknown factors. None of the

[illegible] as been with multiple pest problems [illegible] other pests in [illegible] would-be cost [illegible] mosaic [illegible]

[illegible] associated with [illegible] (the cotton [illegible] rose [illegible] and, [illegible] cotton in [illegible] cotton, [illegible] worms, [illegible] ed that [illegible] ponds to [illegible] [illegible] [illegible] been the [illegible] ve [illegible] lly [illegible] been controlled.

[illegible] thought [illegible] been [illegible] population [illegible] populations were never [illegible] parasites. [illegible] is thought to be [illegible] ve, but its real [illegible] be [illegible] be efficient in [illegible] difficult [illegible] cases [illegible] outheastern Alabama when [illegible] access to artificially infested larv[illegible] excluded from cages, larvae mostly [illegible] lations of most species of parasites are severely [illegible] ved with organophosphates [illegible] organophosphates, [illegible] carbamates [illegible] parasites.

[illegible] in controlling the boll [illegible] was [illegible] conditions, and methods [illegible] insecticides [illegible] provide poor to marginal control of larvae [illegible] moni [illegible] and [illegible] [illegible] and [illegible] operation [illegible]

insecticides or application techniques have given uniform success in controlling larvae of the beet armyworm. Insect growth regulators (IGRs) are effective in killing beet armyworm larvae. However, the IGRs have a long residual and the Environmental Protection Agency has opposed the registration of this class of compounds because of its potential adverse effects on microcrustaceans in non-target habitats. American Cyanamid has a new compound with a new chemistry that appears to give very good control of larvae. Now that the boll weevil is not an economic threat to cotton in the Southeast, exciting new management strategies may be on the horizon for beet armyworm and several other pests on a variety of crops. However, concerted efforts and new philosophies for addressing pest management strategies in boll weevil-free agroecosystems are needed.

RESEARCH NEEDS

Participants of the workshop categorized research needs for the beet armyworm into the broad areas of "Biology, Ecology, and Population Dynamics," "Non-chemical Control," and "Chemical Control". Little to no quantitative data exist on the bionomics, population dynamics, or control technology for the beet armyworm in the Southeast. Hence, pressing research needs must provide basic information that will enhance economical control of the beet armyworm.

1. Biology, Ecology and Population Dynamics:

   A. Fundamental Biology- Research is needed on the insect's life cycle, feeding behavior and food preference of larvae, mating and migratory behavior of adults, reproductive physiology, fertility and fecundity of adults, genetics, bio-systematics (including biotype and strain development), color phase development in larvae, and biochemical mechanisms governing the development of resistance to pesticides. (Not ranked among six priority research needs)

   B. Biotic Factors- Efforts should be made to identify and understand interactions among the beet armyworm and its natural enemies (parasites, predators, pathogens) and wild host plants (refugia) in overwintering habitats and agricultural systems, so that management strategies can take advantage of natural mortality factors that adversely impact its populations. (Co-ranked fourth among six priority research needs)

C. Abiotic Factors- Information is needed on how weather, soil type, soil water, cropping practices, pesticide use patterns, pest management strategies, physiography, and other environmental factors affect population of the beet armyworm. (Co-ranked fourth among six priority research needs)

D. Monitoring/Survey, Sampling and Economic Thresholds- There currently exist no data on which to base sound scouting techniques, population estimates, or decision making recommendations for economical control of the beet armyworm. Therefore, research is necessary to establish reliable monitoring/survey technology, accurate sampling protocols, and data-based economic thresholds for treating populations of the beet armyworm. (Ranked first among six priority research needs)

E. Prediction Capability- Ecological/environmental factors that trigger outbreaks of the beet armyworm, and caused its shift to become an early-season pest in the Southeast, are poorly understood. To develop reliable prediction capability for the beet armyworm, research is needed on its pre-season and/or early-season bionomics in overwintering habitats, migration dynamics (including aerobiology of adults), and early-season habitat selection criteria for immigrant populations. (Ranked second among six priority research needs)

F. Area-Wide Management Strategies- Eradication of the boll weevil from the Southeast will permit unknown and possibly unlimited, new management strategies for several pestiferous insect species. Therefore, research is needed to develop environmentally compatible, biologically based control technology that will take advantage of weak links in the beet armyworm's life cycle (egg, larval, pupal and adult stages) over large geographical areas. Successful pursuance of this research will require the integration of knowledge gained from completing objectives of other priority research needs. (Not ranked among six priority research needs)

Abiotic Factors- Influence [illegible] weather, soil [illegible] predictors, predictive [illegible] patterns [illegible] strategies [illegible] environments [illegible] system [illegible] priority [illegible]

[illegible]

E. Population Dynamics [illegible] overwintering [illegible] of the [illegible] diapause [illegible] early-season [illegible] migration [illegible] of adults), and early-season [illegible] tion criteria for [illegible] (Ranked second among six priority [illegible] needs.)

F. Area-Wide Management Strategies- Eradication of the boll weevil from the Southeast will permit unknown and possibly unlimited [illegible] management strategies for several [illegible] insect species. Therefore, research [illegible] to develop environmentally compatible [illegible] ically based control technology that will take advantage of weak links in the [illegible] life cycle (egg, larval, pupal and adult) stages over large geographical areas [illegible] control. Pursuance of this research will [illegible] minimization of knowledge [illegible] ing lacking objectives or other priority [illegible] research needs. (Not ranked among six priority research needs.)

2. Non-Chemical Control:

   A. Biological Control- Subjective observations and evidence suggest that natural enemies have a significant negative impact on beet armyworm populations in the Southeast. To delineate the impact of natural enemies, and to integrate them into economically sound management systems, research is needed to survey, identify, quantify, and prioritize the efficacy of parasitic and predaceous insects, nematodes and pathogens (viruses, fungi and bacteria), determine environmental factors that influence their regulatory efficiency, and develop strategies (conservation, augmentation, manipulation, etc.) that will enhance their utility in pest management systems. (Ranked third among six priority research needs)

   B. Cultural Control- Farming operations and other activities of man are seldom neutral toward populations of other organisms sharing an agro-ecosystem. To enhance the use of cultural control or a management strategy for the beet armyworm, research is needed to delineate the positive/negative effects of cropping practices, soil types, irrigation techniques, planting date, crop varieties/hybrids, weed control and crop resistance (both, classical and transgenic), and integrated pest and farm management practices on the beet armyworm and its natural enemies. (Not ranked among six priority research needs)

   C. Autocidal Control- Species hybridization and irradiation technology have been used effectively to introduce hybrid and inherited sterility into relatively closed populations of the tobacco budworm and corn earworm/cotton bollworm in isolated island and mountain valley environments, respectively. Also, sublethal doses of irradiation have been used in the laboratory to produce adverse genetic and biological effects on the fall armyworm and beet armyworm. Research is needed to further document inherited sterility and transgenic effects on population processes of the beet armyworm, and how these effects may be integrated into area-wide management strategies. (Not ranked among six priority research needs)

3. Chemical Control:

Despite some of its undesirable attributes, e.g., costliness, inefficiency and adverse environmental effects, chemical control technology remains the foundation for suppressing populations of pestiferous insects. Therefore, research is needed to maximize its efficiency while minimizing its adverse environmental effects, so that this desirable and generally cost-effective technology may continue to be integrated into management systems for the beet armyworm.

A. Application Technology- Available equipment and conventional application procedures provide unpredictable, often unacceptable, control of the beet armyworm for the diverse production practices found in the Southeast. Research is needed in pesticide application technology to: improve equipment design and delivery systems for more effective application of pesticides; identify and evaluate formulation additives (crop oils, spreaders, stickers) for optimum placement and retention of pesticides in targeted sites on plants; and develop and evaluate new compounds and biorational formulations of IGRs, B.t., viruses, fungi, etc., that enhance biologically based components of integrated control systems for the beet armyworm. (Ranked fifth among six priority research needs)

B. Pesticide Efficacy- The efficacy of registered compounds varies greatly, often resulting in unsatisfactory control of the beet armyworm in the Southeast. Research is needed to identify and evaluate the performance of existing pesticides under the varying conditions that occur in the Southeast, evaluate efficacies of new formulations of existing compounds, and evaluate compounds with new chemistries and/or modes of action against the beet armyworm. (Ranked sixth among six priority research needs)

C. Resistance Management- The development of resistance to pesticides is a common evolutionary occurrence for insects whose populations are subjected to repeated application pressures. To extend the useful life of

effective compounds for beet armyworm control in the Southeast, research is needed to develop efficient monitoring techniques for detecting shifts in susceptibility to available and new compounds, and to develop strategies for extending the useful life of compounds in the Southeast. (Not ranked among six priority research needs)

ARS Role in Beet Armyworm Research

The Agricultural Research Service (ARS) currently has formal research (CRIS) programs at Phoenix, AZ on Cotton resistance to pests and Gainesville, FL on the use of pheromones for monitoring insect populations that incorporate the beet armyworm as an indicator species. In addition, the ARS conducts research on sampling/scouting methodology (Mississippi State, MS), foraging behavior of *Cotesia marginiventris* (Gainesville, FL and Tifton, GA), and pesticide efficacy (Stoneville, MS and Weslaco, TX) that is applicable to beet armyworm problems (Table 2). The ARS also has research programs that may be suitable for partial redirection within available resources for beet armyworm research in the priority research needs of prediction capability (College Station, TX), natural enemy enhancement (Tifton, GA and Stoneville, MS) and efficacy factors (Gainesville, FL and Tifton, GA), abiotic/biotic interactions (Gainesville, FL and College Station, TX), and pesticide application technology (Tifton, GA, College Station, TX, and Stoneville, MS). Additional resources would be needed for the ARS to begin new research or expand existing research programs on prediction capability (Tifton, GA and College Station, TX), natural enemy enhancement (Tifton, GA), and pesticide application technology (Tifton, GA) for the beet armyworm.

(Report compiled by Charlie E. Rogers, Tifton, GA)

Table 1. Relative agricultural losses caused by major lepidopterous pests in Georgia[1].

	Estimated dollars lost (X 1,000) caused by											
	Beet armyworm[3]			Fall armyworm[4]			Corn earworm[5]			Tobacco budworm[6]		
Year[2]	Damage	Control	Total	Damage	Control	Total	Damage	Control	Total	Damage	Control	Total
1985	63	33	96	2,741	1,528	4,269	6,293	10,838	17,131	11,642	7,561	19,203
1986	3,208	1,485	4,693	1,242	1,112	2,354	5,406	5,687	10,732	7,106	5,636	12,742
1987	1,146	836	1,982	689	527	1,216	4,733	5,348	10,079	9,304	7,642	16,946
1988	4,980	9,809	14,790	455	147	602	2,925	7,002	9,927	4,545	5,833	10,378
1989	6,765	6,783	13,547	482	463	945	5,956	11,184	17,140	4,850	5,772	10,622
1990	13,790	17,720	31,115	2,682	2,002	4,684	8,140	8,393	16,534	6,879	8,117	14,996
Total	29,952	36,066	66,619	8,291	5,799	14,070	33,453	48,452	81,543	44,326	40,561	84,887

1/ Data extracted from Douce and McPherson. Summary of losses from insect damage and costs of control in Georgia, 1988 and 1989; and from Lambert, Cotton Insects Report for 1990 volume of "Summary of losses..."

2/ For years 1971-1984, ranking for Georgia was CEW, 1; TBW, 2; FAW, 3; BAW, 4. For 1988-1990 BAW ranked 13, 17, and 1, respectively, compared with No. 19 and 3 for TBW in 1988 and 1990, and No. 13 and 4 for CEW in 1988 and 1990 in Georgia's top 20 worst pests (FAW was not in top 20 for 1988-1990).

3/ Spodoptera exigua (Hübner).

4/ Spodoptera frugiperda (J. E. Smith).

5/ Helicoverpa zea (Boddie).

6/ Heliothis virescens (Fabricius).

TABLE 2. STATUS OF PRIORITIZED BEET ARMYWORM RESEARCH NEEDS FOR THE SOUTHEAST.

Ranked Research Need	Research Status: Currently in Progress	Possible with Available Resources	Additional Resources Needed to Implement
1. Sampling/scouting and economic thresholds	ARS; T. L. Wagner/J. L. Willers		UGA; G. A. Herzog
2. Prediction capability: a. Overwintering habitat b. Dynamics of migration		ARS; J. K. Westbrook/W. W. Wolf IFAS; R. K. Sprenkel	ARS; Tifton ARS; College Station IFAS; R. K. Sprenkel
3. Natural enemies a. Survey, identification, quantification, and prioritization			ARS; A. M. Simmons ARS; H. R. Gross UGA; G. A. Herzog
b. Enhancement (conservation, augmentation, behavior, and evaluation)	ARS; W. J. Lewis/J. H. Tumlinson	ARS; C. E. Rogers/O. G. Marti ARS; J. J. Hamm ARS; J. E. Carpenter ARS; M. R. Bell	Clemson; S. G. Turnipseed ARS; H. R. Gross ARS; A. M. Simmons
c. Efficacy factors (abiotic, biotic, and cropping practice		ARS; W. J. Lewis/J. H. Tumlinson UGA; G. A. Herzog	
4. Interactions: Pests, natural enemies, crops, weather, soil, and others		ARS; J. H. Tumlinson ARS; J. K. Westbrook UGA; G. A. Herzog	
5. Pesticide application technology a. Equipment		ARS; L. D. Chandler ARS; H. R. Sumner ARS; L. F. Bouse ARS; J. R. Williford	ARS; L. D. Chandler ARS; H. R. Sumner
b. Additives	Clemson; M. J. Sullivan et al.		ARS; L. D. Chandler
6. Pesticide Efficacy	Auburn; W. J. Moar Clemson; S. G. Turnipseed UGA; G. A. Herzog ARS; G. W. Elzen ARS; D. A. Wolfenbarger		

Appendix A

Beet Armyworm Workshop Agenda
October 22, 1991
Insect Biology & Population Management Research Laboratory
Tifton, GA

8:30	Welcome/Introductions - C. E. Rogers, Coordinator
8:35	Purpose/Charge - J. R. Coppedge/R. M. Faust, National Program Leaders
8:40	Farmer's Experiences - J. R. Coppedge, Moderator Glen Gullage, Hedland, AL Jimmy Mobley, Shorterville, AL Bob McLendon, Leary, GA Mike Newberry, Arlington, GA
9:30	Industry Perceptions - J. R. Coppedge, Moderator Danny Bennett, Consultant, Cochran, GA Andy Jordan/Frank Carter, National Cotton Council, Memphis, TN
9:50	Break
10:10	Extension Perceptions - J. R. Coppedge, Moderator Ronald Smith, Auburn University, Auburn, AL Bill Lambert, University of GA, Rural Development Center, Tifton, GA
11:00	Research Status in the Southeast - J. R. Coppedge, Moderator Mike Gaylor, Auburn University, Auburn, AL (R. Smith) Mike Sullivan, Clemson University, Edisto Station, Blacksville, SC James Smith, ARS, Boll Weevil Research Lab, Mississippi State, MS Larry Chandler, ARS, Insect Biology & Population Management Research Lab, Tifton, GA Gary Herzog, University of GA, Coastal Plain Experiment Station, Tifton, GA Joe Lewis, ARS, Insect Biology & Population Management Research Lab, Tifton, GA
11:50	CRIS Projects Review - C. E. Rogers
12:00	Lunch
1:15	Research Needs - R. M. Faust, Modertor All Participants

2:30	ARS Role In Research - R. M. Faust, Moderator All Participants
3:15	Break
3:30	Comments from Area Office - E. L. Corley, Director South Atlantic Area, Athens, Ga
3:45	Report Development - J. R. Coppedge Interested Participants
4:00	Wrap-up/Adjourn - R. M. Faust/J. R. Coppedge

Appendix B

WORKSHOP PARTICIPANTS

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